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MIXED WASTE FOCUS AREA
TECHNOLOGY DEVELOPMENT REQUIREMENTS DOCUMENT

Mercury Amalgamation

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U.S. Department of Energy
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Mercury Amalgamation

Revision -

1.0 Scope

This technology development requirements document (TDRD) establishes the end-user performance, flexibility, and implementability of amalgamation processes in stabilizing elemental mercury, including condensed residues from retorting and/or roasting processes. This TDRD is specifically applicable to the use of relatively large-quantity batch processing systems to meet Resource Conservation and Recovery Act (RCRA) treatment standards..

1.1 Technology Deficiency Description

Mercury is one of the most difficult contaminants to stabilize in hazardous or mixed waste. Portland cement does not directly stabilize either elemental mercury or mercury salts, and high temperature techniques such as incineration and vitrification volatilize mercury, producing offgases that require further treatment. Even the lower temperatures (relative to incineration) used in sulfur polymer cement (SPC) encapsulation can volatilize mercury contaminants.

In 40 CFR 268.40, RCRA defines several categories of mercury wastes, each of which has a defined technology or concentration based treatment standard, or a Universal Treatment Standard (UTS). For nonwastewaters with mercury contaminant concentrations greater than or equal to 260 mg/kg *and* RCRA-regulated organic contaminants (other than incinerator residues), incineration or retorting (IMERC or RMERC) is identified as the treatment standard. For nonwastewaters with mercury contaminant concentrations greater than or equal to 260 mg/kg that are inorganic, including incinerator and retort residues, RMERC is the identified treatment standard. Amalgamation (AMLGM) is identified as the treatment standard for radioactive elemental mercury. However, radioactive mercury condensates from RMERC processes will also require amalgamation. Additionally, residues from IMERC processes with greater than 260 mg/kg of radioactive mercury contamination will require RMERC, followed by AMLGM of the condensate. IMERC residues with less than 260 mg/kg will also require some form of stabilization (i.e., SPC) to meet the RCRA Toxicity Characteristic Leaching Procedure (TCLP) limit for mercury of 0.20 mg/l. This procedure is described in Method 1311 of U.S. Environmental Protection Agency (EPA) Publication SW-846. The point of this discussion is that, due to regulatory requirements, radioactive elemental mercury will be generated from several sources in the DOE complex. These waste streams will require amalgamation.

Historically, mercury amalgamation has been used to extract precious metals (i.e., gold, silver) from metal ore. For example, gold is amalgamated with mercury and this amalgam is then extracted from the ore. The amalgam is then retorted to volatilize the mercury and recover the gold. The definition of amalgamation provided in RCRA 40 CFR 268.42, Table 1 indicates that the primary purpose of the process is to reduce the emission of elemental mercury vapors into the air. In addition, the final waste form requirements must also be met, through adherence to the UTS or a defined technology-based treatment standard. The only known commercial amalgamation process that shares similar waste form requirements is production of dental amalgams for tooth restoration. However, this process is only performed on a very small scale, generally using a mortar and pestle to develop the amalgam.

Several treatability studies and other development efforts have been performed throughout the DOE complex related to amalgamation of mercury wastes. Tests have been conducted to evaluate the ability of several different materials to stabilize mercury, including tin, zinc, copper, sulfur, and SPC. Sulfur and SPC stabilization techniques actually involve a reaction that forms a chemical compound (HgS), which significantly decreases the vapor pressure of the mercury. In contrast, amalgamation processes using zinc, tin, or copper form an alloy with mercury, and do not involve a chemical reaction. However, the RCRA definition for amalgamation, found at 40 CFR 268.40, includes sulfur as an acceptable inorganic reagent. Consequently, for purposes of this TDRD, any mercury stabilization process that meets the RCRA definition will be referred to as amalgamation.

As previously stated, treatability studies using various materials to stabilize mercury have been conducted within the DOE complex; however, these studies have been at a bench scale level only. Consequently, the primary deficiency with amalgamation of mixed waste is related to scale-up of the process to a cost-effective operations level. Successful amalgamation is based on several parameters. These parameters, listed below, are dependent on the size of the operation, are themselves interdependent, and will have to be optimized during the scale-up process. In addition, these parameters may or may not be applicable, depending on the basic amalgamation process chosen.

1.1.1 Liquid-solid reactions are extremely surface area dependent. Thus, pretreatment may be required to enhance the based on the process chosen. Acid dissolution and grinding of the amalgamating material with steel balls (added to the mixing unit) can be used to improve the process effectiveness. Acid type, concentration, residence time, and amount must be determined. Grinding ball size, amount, residence time, and type of coating (if required) must be determined. Effective use of pretreatment processes affects the waste loading that can be achieved.

1.1.2 The process mechanism must be defined. Paint shakers have been successfully demonstrated for performing mercury amalgamation. In addition, particle beds and ultrasonic agitation have been demonstrated; however, limited research has been performed using these mechanisms. For the use of paint shakers, parameters such as shaker angle, cyclic speed, and volumetric capacity must be defined. Similar parameters would have to be defined for other mechanisms.

1.1.3 The particle size of the amalgamating material chosen must be optimized. Particle sizes ranging from 840 µm to 25 µm have been experimentally shown to have varying degrees of success in enhancing the amalgamation process, depending on the amalgamating material used

1.1.4 Acceptable levels of free mercury in the final waste form must be controlled. As previously identified, various pretreatment methods can be used to minimize the free mercury in the amalgam by removing oxidation and increasing surface area. These methods include acid dissolution, mechanical energy input (i.e., grinding). In addition, in-process and post treatment steps can be used to reduce free mercury in the final waste form. These include the use of surfactants to disperse elemental mercury in the amalgam, and input of microwave energy. As previously stated, the type, amount, and residence time for pretreatment must be optimized. The surfactant *bacterial lysate* has been shown to successfully disperse mercury, but operating parameters would have to be determined for the specific amalgamation system chosen, if this method is utilized. Parameters associated with microwave energy input would also require definition. The process will probably never be 100% effective, but treated materials must pass TCLP.

1.1.5 Optimal waste loading, by weight percent, must be defined for the system chosen. Waste loadings may be different, depending on the amalgamating material utilized and waste characteristics. In addition, the degree of pretreatment may affect the waste loading.

1.1.6 In regard to final waste form performance, several questions must be resolved prior to design of the production scale system. Specifically, the final waste form produced by the process must meet the waste acceptance criteria (WAC) of the proposed disposal facility. If a radioactive elemental mercury waste stream is amalgamated, it meets the RCRA Land Disposal Restrictions (LDRs) (40 CFR 268) and can be disposed in a RCRA 40 CFR 264.301 Subtitle C disposal facility. However, if the amalgam is shown to meet the TCLP limit of 0.20 mg/l, the treatment residue can be disposed in a RCRA 40 CFR 264.301 Subtitle D disposal facility. Thus, the treatment/verification process will be dependent on the intended disposal facility. All treatment residues should preferably meet Subtitle D disposal requirements, since Subtitle C disposal capacity is limited and much more costly. Certain facilities may accept containerized mercury for disposal, while others may require the amalgam to be stabilized (i.e., encapsulation in SPC). These requirements will also affect the final process design.

1.1.7 Certain amalgamation processes are considered less desirable for DOE mixed waste due to cost or performance limitations. Generally, amalgams using precious metals (i.e., gold, silver) would be cost prohibitive for full scale implementation. In addition, amalgams using tin and zinc have been demonstrated to not provide an acceptable final waste form. However, alloys using these metals have not been evaluated and may provide an acceptable, cost-effective amalgamation process.

1.1.8 Most of the elemental mercury waste streams in the DOE complex contain other contaminants and impurities. Data has not been developed to determine the weight percentage for organics, metals, and other contaminants that the amalgamation process can accept and still produce a viable final waste form. This is particularly critical to treatment residuals destined for RCRA Subtitle D disposal facilities. Specifically, information should be gathered pertaining to the affects of water, chlorine, nitrates, sodium, and vacuum pump oil on amalgamation processes. The affects of other contaminants expected to be in the existing mercury waste streams, including those generated from retorting and similar processes, should be evaluated.

2.0 End-User Treatment Systems

2.1 Treatment Systems

Several treatment systems in the DOE complex have been identified to provide amalgamation of radioactive mercury or produce radioactive elemental mercury that will require subsequent amalgamation. Table 1 gives some examples of these facilities, and the applicable states.

2.2 Proposed Treatment Sites and States

Examples of the proposed treatment sites and states for amalgamation of radioactively contaminated mercury are shown in Table 1,which is attached. As previously mentioned, these include radioactive elemental mercury waste streams generated from other treatment processes.

2.3 Target Waste Streams

Over 38,000 m^3 of mixed low-level and transuranic waste have been identified in the DOE complex, at virtually every site, that contain radioactive mercury contamination, or are radioactive elemental mercury (EPA Code D009). Generally, any waste stream suspected of having mercury constituents (e.g., through process knowledge) is assumed to be contaminated at a high enough concentration that the waste streams would not pass a TCLP test. In reality, some portion of this volume will meet TCLP requirements and not require treatment for mercury contamination. However, a substantial amount of waste will remain that requires treatment. Currently, approximately 5.95 m^3 of elemental liquid mercury exists in the DOE complex that will require amalgamation. In addition, the mercury extracted from other waste matrices through planned treatment processes (i.e., Defense Waste Processing Facility at Savannah River Site, Advanced Mixed Waste Treatment Facility at INEL), which will generate an estimated 2 to 3 drums of radioactive elemental mercury annually, will require amalgamation. Estimation of the total amount of elemental mercury that the DOE will have to amalgamate is difficult. But, extracted mercury and newly generated volumes of elemental mercury could potentially double the current inventory.

The Oak Ridge Reservation (ORR) has many waste streams, which include substantial quantities of mercury contaminated mixed waste and radioactively contaminated elemental liquid mercury.

Table 2 provides a sampling of the different types of waste matrices and quantities of mercury waste streams at ORR. The waste matrices presented in this table are representative of those in the DOE complex.

3.0 End-User Requirements

3.1 Primary Functional Performance Requirements

3.1.1 In RCRA 40 CFR 268.40, the treatment standard for elemental mercury contaminated with radioactive materials is identified as amalgamation (AMLGM). AMLGM is defined in RCRA 40 CFR 268.42, Table 1. as "Amalgamation of liquid, elemental mercury contaminated with radioactive materials utilizing inorganic reagents such as copper, zinc, nickel, gold, and sulfur that result in a nonliquid, semi-solid amalgam and thereby reducing potential emissions of elemental mercury vapors to the air." The process utilized must satisfy this definition.

3.1.2 The amalgam must provide a waste loading of at least 50% by weight to minimize disposal volumes, and provide a cost-effective process.

3.1.3 The process should minimize formation of mercuric oxide (HgO) by using ambient temperature processes. If an elevated temperature process is used, mitigating steps must be implemented to minimize and control mercury vapors (i.e. use of an inert sweep gas). This is necessary due to the relatively high solubility of HgO in water, which can cause amalgams to fail TCLP testing.

3.1.4 The process must not release mercury vapors into the environment above the limits established by the applicable air permit [in accordance with Clean Air Act (CAA) requirements]. In addition, the process should not expose operators to mercury vapors above the established Threshold Limiting Value (TLV) of 0.05 mg/m^3. (Note that the Immediately Dangerous to Life and Health limit is 28 mg/m^3.)

3.1.5 The process must minimize secondary waste streams. Processes typically use an acid to help remove oxidation from the surface of the amalgamation metals, which produces secondary wastewaters that are radioactive and hazardous and must be treated to RCRA standards. Some bench scale processes that have been demonstrated would generate unacceptable amounts of secondary waste streams when scaled-up. The process utilized must be designed to minimize or eliminate secondary waste streams.

3.1.6 The process should minimize free elemental mercury in the final waste form. Generally, concentrations above approximately 4.5% free mercury result in a final waste form that exceeds the TCLP limit of 0.20 mg/l.

3.1.7 The final waste form must exhibit insignificant decomposition in a temperature range of -40°F to 140°F and in environments of all pH ranges, especially alkaline environments.

The temperature range provided correlates to environments common to DOE mixed waste storage facilities. Using the TLV as a basis, the final waste form must have a vapor pressure of less than 10^{-6} torr at 140°F.

3.2 Operational Conditions

3.2.1 Generally, amalgamation processes should occur at ambient temperatures, depending on the process used, to minimize mercury volatility. However, the efficiency of the amalgamation process is dependent on the mercury being in the liquid phase. The melting point of mercury is approximately 10°F. The amalgamation process should be kept above this temperature

3.2.2 The process offgases, if produced, should be controlled to ensure that the TLV limit for mercury, 0.05 mg/m^3, is maintained in the vicinity in which workers are located. Depending on the process chosen, mercury monitors may be required.

3.2.3 The mercury waste identified in the DOE complex is generally contact-handled (less than 200 mR/hr). Therefore, high dose rates are typically not a consideration.

3.2.4 While the presence of moisture in the process mixture may not affect the amalgamation, it also does not enhance or improve the process and only adds secondary waste stream volume. Moisture in the feed streams should be minimized.

3.3 Throughput

To date, only bench scale treatability studies have been conducted for amalgamation processes. Scale-up to a level that would provide treatment capacity in a single facility to process the existing inventory in less than 4 to 5 years is not practical, based on treatability studies. The solution will most likely consist of multiple treatment systems. Data developed to-date suggests that the maximum practical throughput for a single 8-hour shift operation is approximately 100 lbs per day. This is based on using multiple 5-gallon paint shakers, with a 4-hour total preparation and processing time. Any system designed should provide comparable throughput.

3.4 Duty Cycle

Mercury amalgamation processes shall be designed to operate one 8-hour shift per day, five days per week. These processes are expected to use mostly commercially available equipment (i.e., paint shakers) that should be able to readily accommodate this duty cycle.

3.5 Reliability

The paint shakers expected to be used for amalgamation processes are commercially available. This equipment has been used commercially and proven to be reliable for industrial use. This is also true for ultrasonic agitators. For other amalgamation processes that may be chosen (i.e., dry bed amalgamation), these process must be shown to be as reliable as the other options that utilize commercially available equipment. In addition, reliability of the process quality control must be demonstrated for all amalgamation processes.

3.6 Maintainability

The amalgamation equipment shall be designed such that routine operations and maintenance require minimum personnel exposure. In addition, the worker effort and secondary waste stream generation during decontamination of any amalgamation system should be minimized. Appropriate monitoring equipment shall be installed on amalgamation systems to ensure safety, minimize worker exposure, and control quality of the process.

3.7 Ambient Environmental Conditions

The ambient conditions should be amenable to the particular amalgamation process used. Industrial equipment utilized should be operated within the envelope defined by the manufacturer. In addition, the conditions must be such that the workers can perform safely and reliably, while maintaining process quality. Based on processes demonstrated in treatability studies, mercury amalgamation of DOE wastes should be performed in an environmentally controlled and protected location.

3.8 Transportability

Transportability is a desirable feature; however it is not required.

3.9 Physical Characteristics

For treatment residuals that must be shipped to a disposal facility via an interstate highway, U.S. Department of Transportation (DOT) limitations (49 CFR 173) will be applicable. Of specific interest will be the weight limitations of shipping containers. Although DOT specifications have adopted performance based container design, which allow a site to design a new shipping container to meet specific needs, typical shipping containers, such as 55-gal drums, have established weight limitations. Using the 55-gal drum example, these containers generally have a shipping weight limitation of 800 lbs. However, a full drum of a typical final waste form from a RCRA amalgamation process would weigh approximately 3,500 lbs (based on 50% weight loading, mercury density of 850 lbs/ft^3, and sulfur density of 125 lbs/ft^3) at a minimum. This would allow a 55-gal drum to be only 1/4 full. However, under RCRA 40 CFR 265.315, containers disposed in a Subtitle C or Subtitle D landfill must be 90% full. The actual amount of amalgam that can be placed in a container will be dependent on the container design, as well as the amalgamation process chosen. In addition, hoisting limitations at the disposal facility may determine the ultimate size and weight of a container.

3.10 Waste Acceptance Criteria

RCRA 40 CFR 264, Subpart B discusses general waste characterization requirements that are applicable to all hazardous waste Treatment, Storage, and Disposal (TSD) facilities. It specifies that a detailed chemical and physical analysis of a representative waste sample must be performed prior to waste treatment and management. The final waste form must be such that it will pass LDRs or TCLP, as applicable, when analyzed according to the requirements set forth in this regulation, and as implemented by the disposal facility. Specifically, the process used to treat the waste must meet the RCRA definition of amalgamation to allow land disposal of the amalgam in a RCRA Subtitle C landfill. Additionally, the amalgamation process must result in a final waste form that provides leachability of mercury below 0.20 mg/l, based on TCLP testing, if the treatment residue is to be disposed in a RCRA Subtitle D landfill.

As previously stated, the process must produce a final waste form that is acceptable for land disposal at the targeted facility. Depending on the facility WAC, the amalgam may not be acceptable as a final waste form due to various reasons (i.e. decomposition, compressive strength, etc.) In these cases, the treatment train may include a final process that can provide an acceptable final waste form (i.e., SPC encapsulation).

Additionally, existing Subtitle C and Subtitle D disposal facilities are generally limited to contact handled waste (i.e., < 200 mR/hr). The radiation limits of the target disposal facility must be considered when determining the process WAC and final waste form.

4.0 Key Regulatory and Safety Requirements

Operation of any amalgamation process system must meet the applicable standards of RCRA, the CAA, and other applicable regulations. The primary regulatory driver is to meet RCRA LDRs (40 CFR 268) or TCLP limits, as appropriate. In addition, based on the assumption that the scale and scope of this process would be outside the boundaries of RCRA treatability studies and/or RCRA Research, Development, and Demonstration permits, any amalgamation system would be regulated under RCRA 40 CFR 264 Subpart X, Miscellaneous Units. Any amalgamation process should also conform to applicable Occupational Safety and Health Association (OSHA) requirements found at 29 CFR 1910.

At 10 CFR 1021, DOE has defined implementing procedures and guidelines for requirements established by the National Environmental Policy Act (NEPA). If operational activities are conducted at, or below, the level of research/pilot scale operations, a NEPA Categorical Exclusion would apply. If operational activities exceed the indicated level, a NEPA Environmental Assessment will be required. DOE also has regulations, which must be adhered to, that dictate methods to properly manage the radioactive components of mixed waste such that radiological exposures to personnel are kept “as low as reasonably achievable” (ALARA).

The designer shall prepare and maintain a preliminary hazard assessment on the proposed research at the initiation of the project in accordance with or similar to hazard assessments required by DOE Order 5480.23, as appropriate. At the end of the project, the principal investigator should prepare a hazard evaluation of the technology with respect to the mixed waste expected to be treated in the system. This assessment shall be included as part of the final report. Additionally, any safety anomalies encountered during the development and demonstration or "lessons learned" relative to safety of the system shall be included in the final report.

5.0 Schedule Needs

Based on the MWFA Integrated Master Schedule (IMS), the earliest need for a production scale mercury amalgamation process is related to the process residuals that are expected to be generated by the Transportable Vitrification System (DP-S809). Elemental mercury condensed from offgases resulting from vitrification of mercury contaminated wastes will require amalgamation at Oak Ridge. The site-specified start date for technology development is May 1999. In addition, the Defense Waste Processing Facility at Savannah River Site, which vitrifies high level waste, initiated operations in May 1996. This facility is expected to generate 0.1 m^3/yr to 0.2 m^3/yr.

6.0 Public and Tribal Involvement

The MWFA Tribal and Public Involvement Resource Team shall keep the principal investigators and Waste Type Team informed of tribal and public issues, needs and requirements associated with technology development activities, and of opportunities to involve tribes and the public in these activities. The principal investigators shall participate in tribal and public involvement activities as requested by the Tribal and Public Involvement Resource Team. This Team shall prepare and maintain the Record of Tribal and Public Involvement, as appropriate, for each technology development project.

7.0 Quality Assurance and Testing

Development and demonstration shall be conducted in accordance with a written quality assurance plan (QAP). For work conducted by or within a DOE facility, the QAP must comply with DOE Order 5700.6C, unless the facility is a Nuclear Facility, as defined by DOE Order 5480.23, in which case the QAP shall comply with 10 CFR 830.120. For work conducted by a non-DOE contractor, outside of a DOE facility, the QAP shall comply with the intent of either DOE Order 5700.6C or ISO-9000. DOE Order 5700.6C and 10 CFR 830.120 can be found on the Internet, respectively, at:

> gopher://cfr.counterpoint.com:2005/00/order/doe/doe5700.6cm, and
> gopher://cfr.counterpoint.com:3010/00/Files/Level1.130/Level2.9.

The QAP must include a test plan that is approved by the appropriate end users and the MWFA. Any test plan developed for mercury amalgamation processes must provide acceptable data quality objectives and be agreed upon by all parties.

8.0 Disposition of Equipment and Waste

After its useful life, the amalgamation equipment must be radioactively decontaminated according to the applicable requirements of 10 CFR 20. If, at the end of its useful life, the equipment is contaminated with hazardous materials, it will be decontaminated according to the appropriate debris treatment standard identified in RCRA 40 CFR 268.45, Table 1. If it is contaminated with RCRA characteristic materials (i.e. ignitable, corrosive, reactive, toxic), it can be disposed in a RCRA 40 CFR 264.301 Subtitle D facility, after treatment. Unless absolutely necessary, the process equipment will not be contaminated with RCRA listed materials; however, if it is the equipment will require disposal in a RCRA 40 CFR 264.301 Subtitle C facility. Decontamination may generate secondary wastes that require mercury extraction, amalgamation, and disposition according to RCRA technology-based treatment standards or UTS. Any RCRA treatment unit must meet the “closure” requirements defined in RCRA 40 CFR 265 Subpart G.

Products from amalgamation of radioactive elemental mercury can be disposed in a RCRA 40 CFR 264.301 Subtitle C facility, provided the process meets the definition of AMLGM, as given in RCRA 40 CFR 268.42, Table 1. Products from amalgamation of radioactive elemental mercury that exhibit leaching characteristics less than or equal to the limit of 0.20 mg/l as defined in RCRA 40 CFR 268.48, Table UTS, can be disposed in a RCRA 40 CFR 264.301 Subtitle D facility. All offsite shipments of mixed waste to and/or from treatment and disposal facilities must be coordinated with state regulatory agencies.

9.0 References

None.

10. Definitions

None.

Table 1. Mercury Amalgamation Treatment Systems

System Name	System ID	Site and State
Advanced Mixed Waste Treatment Project	IN-S150	INEL, Idaho
Mobile Amalgamation Process	PI-S801	Pinellas, Florida Mound, Ohio

		SNL, California Pantex, Texas
Transportable Vitrification System	DP-S809	Oak Ridge Reservation, Tennessee
Central Pollution Control Facility	YP-S002	Oak Ridge Reservation, Tennessee

Table 2. Sample Elemental Mercury and Mercury Contaminated Waste Streams at ORR

Waste Stream ID	Waste Stream Name	MPC Code	CPC Code	RPC Code	Qty (m^3)	Treatment System
DP-W149	Wastewaters	L1000	RC-O11-M12-C14	LL-CH-T90-N90	123.6	CPCF
DP-W162	Soils	S4000	RT-O11-M12-C90	LL-CH-T90-N90	24.3	Commercial
OR-W073	Liquid Mercury	X7100	RC-O90-M12-C90	LL-CH-T90-N90	0.76	Commercial
YP-W195	Inorganic Particulates	S3100	RT-O11-M12-C14	LL-CH-T20-N90	42.2	TVS
YP-W200	Soils	S4000	RT-O11-M12-C12	LL-CH-T20-N90	10.4	Commercial
YP-W204	Inorganic Debris	S5100	RT-O11-M12-C12	LL-CH-T20-N90	2.81	Commercial
YP-W209	Heterogeneous Debris	S5400	RT-O11-M12-C17	LL-CH-T20-N90	26.8	Commercial
YP-W212	Liquid Mercury	X7100	RC-O90-M12-C11	LL-CH-T20-N90	0.13	Commercial
YP-W222	Light Bulbs	S5100	RC-O90-M12-C90	LL-CH-T20-N90	7.57	Commercial

Waste Targeted to Treatment Systems by TD Category

Tech Def # **Tech Def Name** **Waste meeting the screening criteria:**

Criteria: X7100

2 Mercury Amalgamation

INV(m3)
Proj(m3)

ID TRT	TRT Name	Total of all waste targeted to System				
DP-S002	**TSCA Incinerator**	**MLLW:**	**2,578.63**			
		MTRU:	**0.00**			
DP-S809	**Transportable Vitrification System (TVS)**	**MLLW:**	**783.30**			
		MTRU:	**0.00**			
IN-S150	**Advanced Mixed Waste Treatment Project**	**MLLW:**	**24,383.11**	**MLLW :**	**1.27**	**0.53**
		MTRU:	**38,629.78**			

WS ID	Stream Name	MPC	CPC	RPC	INV (m3)	Proj (m3)	WasteType
BN-W007	Inorganic Debris with Mercury Waste	X7100	RC-O90-M12-C90	LL-CH-T20-N20	0.65	0.10	MLLW
SR-W014	TRITIUM CONTAMINATED MERCURY	X7100	RC-O90-M12-C90	LL-CH-T20-N20	0.30	0.10	MLLW
LB-W006	Elemental Mercury	X7100	RC-O90-M12-C90	LL-CH-T19-N90	0.11	0.00	MLLW
SR-W068	ELEMENTAL (LIQUID) MERCURY	X7100	RC-O90-M12-C90	LL-CH-T90-N90	0.10	0.20	MLLW
LL-W024	Liquid Mercury Waste	X7100	RC-O90-M12-C90	LL-CH-T20-N20	0.09	0.05	MLLW
KA-W020	ELEMENTAL MERCURY	X7100	RC-O90-M12-C90	LL-CH-T90-N19	0.02	0.08	MLLW
ET-W023	ELEMENTAL MERCURY	X7100			0.00	0.00	MLLW
KW-W012	ELEMENTAL Hg	X7100	RC-O90-M12-C90	LL-CH-T20-N90	0.00	0.00	MLLW
KK-W016	ELEMENTAL Hg	X7100	RC-O90-M12-C90	LL-CH-T20-N90	0.00	0.00	MLLW
IN-A392A	LIQUID MERCURY	X7100	RC-O90-M12-C90	LL-CH-T20-N20	0.00	0.00	MLLW

Tech Def

meeting the screening criteria:

Tech Def Name

Waste

Criteria: X7100

2 Mercury Amalgamation

					INV(m3)	Proj(m3)
PI-S801	**Mobile Amalgamation Process (Bench Scale)**	**MLLW:** **0.52**	**MTRU:** **0.00**	**MLLW :**	**0.52**	**1.05**

WS ID	Stream Name	MPC	CPC	RPC	INV (m3)	Proj (m3)	WasteType
LA-W920	Elemental Mercury	X7100	RC-O11-M12-C90	LL-CH-T12-N12	0.50	0.05	MLLW
MD-W005	CONTAMINATED MERCURY	X7100	RC-O90-M12-C90	LL-CH-T20-N20	0.02	0.00	MLLW
PX-N042	LIQUID MERCURY	X7100			0.00	0.00	MLLW
SA-W906	Elemental Mercury	X7100	RC-O90-M12-C90	LL-CH-T20-N12	0.00	1.00	MLLW

RL-S802	**Amalgamation at Purex**	**MLLW:** **0.01**	**MTRU:** **0.00**	**MLLW :**	**0.01**	**0.00**

WS ID	Stream Name	MPC	CPC	RPC	INV (m3)	Proj (m3)	WasteType
RL-W006	PUREX STORAGE TUNNELS MERCURY	X7100	RC-O90-M12-C90	LL-RH-T11-N90	0.01	0.00	MLLW

WS-S804	**Amalgamation**	**MLLW:** **0.40**	**MTRU:** **0.00**	**MLLW :**	**0.40**	**0.00**

WS ID	Stream Name	MPC	CPC	RPC	INV (m3)	Proj (m3)	WasteType
WS-W025	LIQUID MERCURY	X7100	RC-O90-M12-C90	LL-CH-T20-N12	0.40	0.00	MLLW

YP-S002	**Central Pollution Control Facility (CPCF)**	**MLLW:** **402.45**	**MTRU:** **0.00**

MLLW	**2.20**	**1.58**